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ABSTRACT

At Wisconsin's Madison Area Technical College (MATC), both external and internal partnerships are a fundamental part of instructional programming. As the need for technological and mathematical competence in the workforce has increased, partnerships between the college and business and industry have become more important and represent an interdependence between MATC and area industry. MATC's external partnerships help fill needs related to curriculum development, program formation and evaluation, and the enhancement of student learning. New programs are scrutinized to insure that local, state, and regional trends will support them. In addition, 33 of MATC's 93 programs have dedicated internships, work experiences, or clinical affiliations which place program students directly into local companies and provide a strong link to many businesses. MATC also enters into formal agreements between business/industry sponsors and program students, in which businesses agree to provide an internship site and an on-site mentor for students. Current partnered programs include an agriculture equipment technology program with John Deere Ag Tech, an automotive technology program with Chrysler, and a bioprocess manufacturing program with a consortium of companies engaged in fermentation and bioprocessing. Other external partnerships are maintained with other higher education institutions for program articulation, links to programs, and faculty cooperation, as well as with K-12 systems. MATC has also created internal partnerships, in which teachers study, share, and create better learning experiences together through seminars courses, and inservice activities. (HAA)

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**Interdependence Through Partnerships:
Transforming Education**

Submitted to the National Science Foundation Roundtable

June 7, 1996

**Submitted by Madison Area Technical College
Dr. Beverly S. Simone, President**

This paper is the result of contributions from an array of staff and faculty directly involved in the respective initiatives identified within the paper.

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Introduction

Madison Area Technical College (MATC) has a rich history in providing math, science and technology curricula as a foundation for its delivery of vocational, technical and adult education. As part of the Wisconsin Technical College System, MATC has a responsibility and need to work closely with business and industry to prepare people for the world of work, to upgrade the skills of those already in the workforce, and to fill the gap between what is learned in K-12 and what is expected by business and industry. This need has increased dramatically as technology demands a more knowledgeable and skilled workforce. The Wisconsin system is characterized by a strong response to the education and employment needs of the local district formalized in a local governing board which includes designated seats for employer and employee members. The nature of the instructional programming at MATC requires partnerships with business and industry. Each occupational program has an advisory committee with employer and employee members that helps develop the program's strategic goals, and review curricula, equipment and facilities.

As the need for a skilled workforce, competent in science and math, has dramatically increased, partnerships reflecting interdependence have become increasingly important both outside and within the college. These same workforce needs require dynamic curricular change and faculty development which cut across traditional disciplinary boundaries. MATC supports a number of initiatives for integrating science, math and technology to facilitate lifelong learning. While partnerships have developed around unique initiatives, there is increasing need for integration between and among the respective partners to achieve systemic institutional reform.

External Partnerships

The concept of partnerships evokes a variety of models used by academic institutions to build and maintain interactions with business and industry. These partnerships are critical if the graduates of a technical program are to become credible employees in business and industry. The depth of the partnership within individual programs is further enhanced as individual companies or consortia of businesses and industries seek to expand and upgrade their employees or seek new training at the college to meet industry needs. MATCs' needs surround curriculum development, program formation and evaluation, and enhancement of student learning.

MATC Program and Curricula Development. MATC program development is structured around a set of state guidelines designed to confirm the need for a new technical or occupational program. The state guidelines seek answers to the past history and the predicted future for occupational trends including expected skills and competencies of entry level workers, expected income, job growth, etc. New programs are scrutinized to insure that local, state and regional trends will support such instructional needs. For example, MATC offers unique associate degree programs in electron microscopy and biotechnology. The curriculum and equipment needs of the programs were defined through the input of business and industry partners via ad hoc program development committees. The ad hoc committees are the foundation for the program advisory committees previously discussed. The Biotechnology Lab Technician (BLT) program was developed in partnership with biotechnology companies and research facilities. The first DACUM (Develop A Curriculum) at MATC was conducted as part of the development of the Biotechnology Laboratory Technician program; the first industry partners projected the curriculum needs, recommended equipment and recruited students.

Student internships and employment of graduates provide a strong link to many businesses; this is particularly true for biotechnology companies. Thirty-three of MATC's 93 programs have dedicated internships, work experiences or clinical affiliations which place program students directly in the job setting. MATC can support biotechnology companies by offering continuing education courses to the partners. Contract training and workshops in new technologies and techniques have been offered to researchers employed in these companies. Students enrolled in the Biotechnology Laboratory Technician program may participate in internships at University of Wisconsin-Madison research laboratories. Some of the internships have connected students to faculty who have encouraged the students to complete their undergraduate degrees or continue with their research projects in university laboratories. For example, the Research Techniques class partnered MATC students with UW-Madison researchers in a consortium project evaluating enzymes produced by the Shiitake mushroom. MATC students participated in basic long term research that was passed from student to student. This partnership between MATC students and the university promotes the credibility of MATC students' abilities and enhances students' transfer to the university. The skills and understanding demonstrated by the students in their internships and research projects allow individual faculty at the university to become acquainted with the depth of the curriculum in the Biotechnology Laboratory Technician program. The projects undertaken by students as part of their curriculum often lead to or strengthen other business and industry links.

Students in the Electron Microscopy (EM) program enroll in a 2-credit special projects course. The course links the EM student to a business or industry problem. Sometimes these are projects or activities outside the company's primary scope, but offer the student an opportunity to

engage in real problem solving. In the past few years, EM students have worked with Johnson's Wax, John Deere, and the Plasma Research Center at UW-Madison to study problems associated with structural failures, mode of action of insecticides, and electron beam-plasma interactions. The project at the Plasma Research Center not only connected EM students to UW-Madison faculty and students, but also provided an opportunity for new internships for Machine Tool students in modifying the EM equipment.

Formalized partnerships with business and industry. In addition to the ongoing partnerships which support one and two year formal programming, MATC has entered into formal agreements between a business/industry sponsor and a program student. The business or industry partner agrees to provide an internship site and an on-site mentor for a student. These internships provide 1,000 to 1,200 hours of paid work-based learning for the student. Current MATC partnered programs include the Agricultural Equipment Technology program (John Deere Ag Tech) and the Diesel Equipment Technology program (Top Tech). The Chrysler Apprenticeship Program (CAP) and the Bioprocess Manufacturing Technician program are scheduled to begin in the 1996-97 academic year. These companies make an investment in their long-term viability, by examining the resources needed to meet their long-term goals, and preparing employees to fill their workforce needs.

John Deere. MATC and the John Deere Company have teamed up to provide an agriculture equipment technology program called John Deere Ag Tech, providing training specifically for the John Deere Company and its dealers. John Deere dealers sponsor students in the program who are then able to apply the skills learned directly on John Deere equipment. When John Deere Ag Tech students are off campus and fulfilling their internships at the company,

the MATC labs and shops, equipped through donations by John Deere, are used for continuing education of other industry employees.

Top Tech. MATC's new associate degree Diesel Equipment Technology Program and a consortium of Wisconsin diesel industries created a partnership called Top Tech. Sponsoring companies offer students paid summer internships. The students work alongside experienced diesel technologists, gain valuable on-the-job training and build their resumes while still in school. In addition, a consortium of industry representatives and MATC instructors shaped the program's curriculum to create highly skilled graduates who can eventually be groomed for supervisory positions. Top Tech focuses heavily on advanced computer and electronics training, diagnosing and troubleshooting abilities, communications and management skills. Demand for highly trained technologists far outweighs the supply of job applicants. By working together to develop Top Tech, MATC and diesel companies can assure program participants that they'll be able to get good jobs when they graduate — and sponsoring companies can look forward to a pool of skilled, experienced employees.

Chrysler Automotive Program. The Zone Office of the Chrysler Corporation asked MATC to join in the development and operation of an educational program that will elevate the level of competency of Chrysler technicians through an associate degree offering in automotive technology. This offering parallels the current associate degree automotive technology program. A section of students partnered with a Chrysler dealer will start in the fall of 1996. The instruction will be based on quarters, rather than semesters, to accommodate student rotation between internship training at MATC and on-the-job experience. Chrysler Corporation provides MATC with a variety vehicle models and repair manuals, software, on-line communication with

Chrysler Corporation, and a vehicle which can be used for traveling to recruit students and visit internship sites.

Bioprocess Manufacturing Technical Program. The newly developed Bioprocess Manufacturing Technician Program is a partnership with a consortium of companies engaged in fermentation and bioprocessing. The program will share similar courses and preparation with the Biotechnology Laboratory Technician (BLT) program, but include increased work-based internships. Students will be able to select programming leading to research "bench" positions or large scale production positions. Large scale manufacturing facilities are not easy to duplicate and are cost prohibitive to build. However, students need direct experience in large scale equipment use, coupled with academic course work, to build the competencies required in this technical area. This program is scheduled to begin in the fall of 1996.

The above partnerships are but a few of the ongoing partnerships with business and industry. These partnerships are mutually beneficial and enhance the learning environment for the student. MATC's partners have donated equipment, vehicles, printing resources, multi-media information, on-site downlinks, and electronic information connections. These are "things" that can be documented and inventoried. The benefits to MATC are faculty enhancement, networks to potential employers through internships and work experiences, and access to changing and advancing technologies. Less obvious are the gains of our business and industry partners. They gain access to: a pool of well-qualified job applicants; continuing education for their employees; shared equipment and new technologies; and technical assistance from college faculty and staff.

Expanding the partnerships: Biotechnology and Metrology/ISO 9001. MATC's Biotechnology Laboratory Technician program and its partners are in the second year of a

National Science Foundation grant of one million dollars. The "Advanced Biotechnology Education Partnership Program" (ABEPP) is a three year project designed to provide skilled employees for the biotechnology industry. This is yet another example of MATC's commitment to education/industry partnerships.

Up-to-date, easily-understood curricula are being developed by MATC, the UW-Madison Teacher Enhancement Program in Biology (TEPB) and the industry-based BioPharmaceutical Technology Center Institute (BTCI). Biotechnology is becoming an increasingly important industry in Wisconsin. High school science teachers realize the importance and are including an introduction to molecular biology in their curriculum. Equipment donations and matching funds from NSF have been effectively utilized as part of a growing "lending library." High school teachers borrow specialized equipment from this library to teach segments on recombinant DNA and other biotechnology-related science. Without opportunities to borrow this expensive and specialized equipment, most schools would not be able to offer laboratory activities in their biotechnology curriculum.

The ABEPP, supported in part by NSF funding, has coordinated several local and state initiatives. Activities to support high school and middle school students include hands-on laboratory activities for students and teachers at BTCI, MATC and UW-Madison. The outreach extends to "mobile" workshops conducted at the schools to avail larger groups of students. Saturday morning career exploration presentations by young scientists draw high school students interested in careers in math, science and engineering. Semester long projects at BTCI with middle school students are designed to increase the science and applied math skills of these younger students. School-to-work activities for high school students include the introduction to

biotechnology course articulated with MATC and the Youth Apprenticeship Program in Biotechnology.

Middle and high school teachers are encouraged to enroll in summer courses or school year workshops coordinated through UW-TEPB. These workshops provide a link to science content, research scientists, and networks among teachers.

Metrology/ISO 9001 Project. MATC's Machine Tool Program received a NSF grant to develop its "Advanced Dimensional Metrology and ISO 9001 Education Partnership Program." This unique collaborative effort also brings together educators and industry leaders: faculty from MATC, the Madison Metropolitan School District and the University of Wisconsin-Madison; the UW Center for Quality, four other community colleges in the U.S. and Canada; local and state public school agencies; and Ford Motor Company, Giddings & Lewis Machine Tool Company and other industries. The partnership was formed to provide the education and training in metrology and ISO 9001 for the engineering, manufacturing and service/installation industries.. Metrology is critical to the success and competitiveness of business and industry and, although conceptually basic, it is often missing in formal educational programs. The teacher enhancement activities and mobile metrology laboratory will allow educational and business/industry partners to incorporate measurements and calibration in mathematics and science courses and applications.

In summary, partnership students benefit from being trained in the latest technologies and in using the latest equipment that MATC either cannot house or purchase. Students receive support for school expenses from the business/industry partners through employment while going to school or tuition reimbursement. Students are also exposed to a potential job after graduation. Employers benefit from partnerships in several ways. Not the least of which is that they are given

a preliminary look at future employees. As business and industries become involved in curriculum development and revision, MATC provides them with a source of employees that are trained in areas important to their particular industry and for an academic evaluation of potential or latest technology and equipment.

While it is logical and obvious to include internships and work experiences in technical programs, it is often difficult to include a work experience component in introductory math and science courses. *There is a need to support pilot programs across the country to experiment with models that identify incentives for employers to participate in work experience activities. Information gained from these pilots could be shared at a national conference. There is also the need to support the development of curricula that provides information about workplace applications for math and science.*

Partnerships with other higher education institutions. Curriculum and instruction in technical occupational programs at MATC are built on a technically and scientifically appropriate core. The content of program core courses must connect to and be supported by mathematics and science courses that build the foundation for the program students. Additionally the science and mathematics courses must be pedagogically sound. Partnerships between MATC and the University of Wisconsin system, particularly UW-Madison are essential to instruction that is credible to employers and other academic institutions. These partnerships include: articulation and transfer agreements enabling students to transfer to/from the UW-system; links to academic programs at UW-system campuses to provide internships and work experiences; and direct participation by MATC and UW faculty in multiple projects. Two NSF supported projects linking

MATC to UW-Madison are systemic chemistry curriculum reform (Establishing New Traditions: Revitalizing the Curriculum) and the National Institute for Science Education (NISE).

Through the systemic chemistry curriculum reform partnership, an MATC faculty member is working with the Department of Chemistry at the UW-Madison to shift undergraduate chemistry curriculum from "faculty centered teaching to student centered learning." Sound undergraduate chemistry curriculum at the community college supports students transferring to 4-year institutions and supports the content of technical/occupational curricula. This collaboration of faculty from the community and 4-year college is necessary if the reform of the freshman chemistry experience is to be successful.

Community college faculty also participate in the National Institute of Science Education. A member of the MATC science department is participating in the project with emphasis on the freshman level science curriculum. Again, the issues of articulation and transferability of students completing technical college courses is predicated on sound instruction (and learning) in the introductory courses.

The community college partners in higher education reform projects need to work with other higher education institutions to assess and develop appropriate science and mathematics courses, especially those introductory courses shared (or taught) by both. Partnerships such as those mentioned above should be expanded and reinforced.

Partnerships with K-12 systems. Science and mathematics preparation through the K-12 system is necessary for students entering technical programs. The articulation of MATC programs with school districts and the post-secondary options programs allow high school students to participate in technical programs while still in high school.

All MATC technical and occupational programs have identified basic science and mathematics preparation necessary for entry into a program. The partnership with K-12 systems is necessary if students are to be successful. *Community college partners in science and mathematics reform projects need to communicate to the K-12 systems the level of competency and understanding needed for technical programs.*

Internal Partnerships

Professional development provided one of the earliest reasons for partnering. There was the recognized need for transforming the way that students were perceived, instruction delivered, curriculum designed and learning assessed. MATC's Critical Literacy Seminar was designed by faculty for faculty to achieve these ends. For one semester a heterogeneous group of 20 teachers are released from teaching one course to study, share, and create better learning experiences together. Participants are chosen to insure a cross-section of the college faculty. Topics such as lecture free classrooms, writing across the curriculum, authentic assessment, and adapting to various learning styles are examined through supplementary readings with topical experts. During the second semester, each faculty member redesigns one course to achieve more student learning. Faculty routinely report much success with this program and stress the importance of the collaboration with other teachers. This seminar is in its sixth year. At this point, 120 teachers have completed it. Many of the speciality seminars have included faculty from surrounding K-12 schools, other technical colleges, and baccalaureate programs in the area.

Emanating from the Critical Literacy Seminar have been other seminars, courses, and in-service activities offered by teachers for teachers. Content areas include diversity, educational

research and reform, assessment, teaching methods, and use of technology to name a few.

Internal partnerships have coalesced as teachers have had the opportunity to collaborate in their individual learning.

Instructional Excellence Initiative. MATC has launched an institution-wide, cross-functional Instructional Excellence Initiative (IEI). Through the IEI, the college commits to nurturing a learning community that maximizes opportunities for student success by utilizing innovative instructional strategies and assessment, collaboration with other partners, and fostering experimentation and planning. No one department has sole responsibility for this initiative; it includes the College President and representation from Instruction, Human Resources (staff development), and Institutional Advancement (research, assessment, program evaluation). The development of the Instructional Excellence vision is interdisciplinary so that efforts throughout the college will be consistent and aligned. The assistance of partners in the K-12 system, the University, business and industry is vital for this vision to be realized and for systemic reform to occur. Current pilot activities funded by this initiative include:

- ▶ Production of videos to provide instruction on the use of electron microscopy for outreach users such as the university.
- ▶ Development of a non-lecture or lecture-lite classroom for the Introduction to Biotechnology course. The pilot will redesign the delivery method of the course to increase the student's active learning. Emphasis will be on the development of a cooperative learning environment where students take charge of their own learning program and further develop critical thinking skills.
- ▶ Development of a "capstone" course, "Bringing Sciences to the 21st Century", which shows the interconnectedness of science, society and the legal issues joining them. The course will be taught by a team of faculty to emphasize the interdisciplinary nature and incorporate collaborative learning strategies.
- ▶ Funding for a Technology Academy which provided the opportunity for teachers to spend

three days learning to use various forms of technology for classroom strategies and management of learning environments.

The IEI addresses the need for "capacity building" in faculty for instructional skills needed to respond to rapidly changing technology and industry standards. The challenge is to provide opportunities and incentives for faculty to stay technologically current, to develop curricula for new technologies, and to explore and utilize new instructional methods to promote student success. *To promote the development and expansion of this type of institution-wide capacity building the following factors should be considered: 1) provide monetary support for equipment to produce materials for alternative instructional delivery (e.g. cd-rom, video); 2) provide support for the development of information technology which supports connectivity and access to information about instructional initiatives; 3) encourage the development of "Curriculum Development Teams" that include content experts, curriculum developers, writers, programmers, and multi-media experts; 4) encourage the development of "Curriculum Development Consortia" to set up shared centers for curriculum development with resident curriculum development teams who would work with faculty from consortia schools; and 5) provide support for a major faculty development initiative.*

Core Abilities Initiative. The MATC Core Abilities Initiative is an institution-wide effort aimed at curriculum transformation to facilitate the integration of general education methods and perspectives with science and technology. The desired outcome of this initiative is to ensure that general education skills essential to learning and functioning successfully in the community and employment are integrated across the curriculum. More specifically for those students whose academics focus on math, science and technology, the goal is to encourage the students to

become aware of her/himself from a variety of perspectives in the context of rapid technological change. At the same time, it is expected that the core abilities will help to ensure those students focusing their academics outside the realm of math, science and technology can integrate elements from these areas into their world view.

The core abilities are content-based rather than course-based. This means that collectively when students graduate from the institution they should be able to master each of the core abilities, regardless of the program. It is intended that no single course will necessarily correspond to any one core ability, nor are core abilities intended to be developed only in General Education courses; courses in occupational programs would also address these abilities. The goal is to have students continually exposed to these key learning areas in occupational courses, thereby consistently demonstrating the influences and importance of the core abilities in the applied setting of work. In this model, multiple perspectives of the core abilities are continually introduced and reinforced across general education and applied environments. The result is math/science integrated, coordinated instructional base setting the stage for lifelong learning. This model can be viewed as a "convergence model". It is the merging of sound instructional practices in general education with applied work settings to maximize student learning.

The eight core abilities identified by MATC faculty are: communications; critical thinking; ethics; global awareness; *mathematics*; self-awareness; *science and technology*, and social interaction. A matrix will be the primary mechanism for identifying these core abilities within courses and assessing the relationship in general education courses and relating and integrating them with program curricula. The matrix will direct attention to gaps, help staff coordinate curriculum to meet the needs of students, and improve course content and instruction. For each

core ability, the matrix will provide greater definition by identifying particular indicators of student achievement. Specific achievement levels in each of the ability areas will be determined by individual programs to ensure a match to the rigors of specific curricula. The goal is for all students to have the opportunity to make significant progress in the core abilities while achieving program objectives. The matrix helps to ensure the centrality of general education at MATC by integrating the core abilities throughout the curriculum, in a developmental and systematic manner.

This initiative is a process for developing curriculum and assessing student learning outcomes. As such, faculty representing all instructional divisions were provided release time to concentrate their efforts on this initiative. Their efforts laid the foundation for the Assessment Implementation Team which will pilot the use of the Institutional Core Abilities Outcomes Matrix during the 1996-97 academic year. Following the pilot, the challenge will be to integrate the system into the fabric of instruction, across all curricula. A three-year plan will be developed to build on standards for course, program and institutional levels of assessment. The core ability matrix will be shared with secondary schools to assist the schools with designing curriculum that addresses the core abilities and better prepares students for the world of work and postsecondary education..

This process for developing curriculum, integrating knowledge and competencies, and assessing student learning outcomes is time and labor intensive. However, as demonstrated by the accomplishments of this initiative to date, it can lead to significant and exponential change in a large, complex system. *There is a need to support and expand opportunities that provide for*

faculty interaction and involvement in the development of curriculum that integrates general education with science and technology.

Critical Literacy, Instructional Excellence and the Core Abilities Initiatives are designed to improve the learning of science, mathematics, engineering, and technology education by all students and result in programs that transcend traditional disciplinary boundaries. Integration of these initiatives into the institutional culture will provide a foundation which supports and advances the goals of science and technology programs. This integration will be enhanced as teachers develop and implement their individualized professional growth plans which relate to their individual needs and draw from the expertise developed through these varied initiatives.

Summary

Historically MATC has filled a major gap for individuals and subsequent employers—it has filled the gap between what is learned in K-12 and what is expected on the job. For instance, an auto body technician may be able to learn many necessary skills for his or her job outside of a traditional classroom. But, auto repair today requires specialized knowledge of metals and paints and how they react to and with each other. To understand these reactions, knowledge of chemistry, physics and math is required. This level of learning cannot be learned on the job and is beyond what the K-12 system offers. MATC fills the gap through general education requirements built into its Auto Body Technician Program and similar programs. The challenge for MATC is to identify the necessary knowledge that transforms the gap into meaningful learning opportunities for students—without duplicating what is offered in K-12 or on the job. Program development

partnerships with employers, such as the program advisory committees, and with the K-12 system help MATC meet this challenge.

As technology has advanced, the gap that MATC fills has increased. While the college has historically depended on partnerships with K-12, universities, and business and industry, this interdependence is now essential for survival. Teachers, administrators and the college as a whole need to develop new skills for collaborating. The college needs to support the individual risk takers who forge new and better developed relationships. In addition to supporting this entrepreneurial spirit there are many challenges that remain for the development of systems that allow colleges like MATC to better meet the needs that are emerging. Some of the questions needing to be addressed are:

- ▶ Are there internal systems for storing and sharing information that can facilitate effectiveness of partnering both inside and outside the college?
- ▶ Are there components (i.e. staff development activities, partnerships, models) basic to all colleges to integrate math and science competencies throughout the curriculum?
- ▶ Are there systemic ways for involving increasing numbers of faculty in partnering initiatives rather than relying on those who are risk takers?
- ▶ Are there competencies which are readily transferable from one partnership to another?
Are they transferable to different organizations? If so, can they be readily taught?